ANALYSIS OF ROAD NETWORK USING REMOTE SENSING AND GIS DATA NAINITAL DISTRICT (UTTARAKHAND)

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Abstract: *Google earth image of Nainital city has been used for this study. Digitization was carried by using Shape file generated for different analysis. ArcGIS based Network Analysis provide multiple solution. The network analysis tool was used to measure the efficiency of services in terms of time and distance. It also help in analyzing the gap existing in the facility, and defining service areas based on travel time and distance covered. The present study tries to analyze the potential use of network analysis Nainital of the Kumaon region. district of Nainital lies in the Kumaun division. Different stretches of roads in Nainital are maintained by NNPP and PWD. The traffic flow in the town causes congestion as there is limited road space available. Traffic restrictions are imposed to manage traffic. There are no intermediate modes of public transport in the town. Taxis are available for inter-city trips and rickshaws are available for journeys between specific points. Most of the internal roads are single lane with a few exceptions. Pedestrian movement in the town is affected because of the absence of footpaths.*

Keywords: *Efficiency, GIS, Network Analysis, Services.*

1. INTRODUCTION:

A network is a system of liner feature that has the appropriate attribute for the flow of objects. A network is a system of interconnected elements, such as lines connecting points. Examples of networks include highways connecting to cities, streets interconnected to each other at street intersections, and sewer and A GIS function called network analysis was used to calculate the time necessary for emergency vehicles to travel from the fire stations to different areas of the city. One major application of network analysis is found in transportation planning, where the issue might be to find paths corresponding to certain criteria like finding the shortest or least cost path between two or more locations, or to find all locations within a given travel cost from a specified origin. Traditionally, a GIS, represents the real world in either one of two spatial models, vector-based, i.e. points, lines and polygons, or raster-based, i.e. cells of a continuous grid surface. This study will investigate the subject of network analysis in both raster and vector GIS, in order to compare the two spatial models. Network analysis is useful for organization that manages or uses networked facilities, such as utility, transmission, and transport systems. Municipal public works department use network to model, analyze bus and trash routes, whereas businesses use them to plan and optimize the delivery of goods and services. Network analysis can also be applied to retail store planning. For instance, solving of the driving times can aid in the determination of retail store trade areas. Network instance, solving of the driving times can aid in the determination of retail store planning. For instance, solving of the driving times can aid in the determination of retail store trade areas.

Therefore network provides the movement of people and goods, the delivery of services the flow of services as well as communication of information. Three Principal types of network analysis are network tracing, network routing and network Allocation

2. NETWORK TRACING:

Network tracing determines a particular path through the network. This Path is based on Criteria provided by the user.

2.1 NETWORK ROUTING:

Network routing determines the optimal path along a linear network. The selection of the Path can be based on numerous criteria such as “shortest distance,” “fastest route,” “no left turns” and minimum cost.” The path can pass between two points or through several selected Points.

2.2 NETWORK ALLOCATION:

As well as one of the most important processes in the Planning and investment activities is Network allocation. GIS has been commonly used in different fields such as tourism activities enabling people from different countries and cultures to interact with each other. Tourism is a way of conserving the environment, creating jobs and

promoting tourism. Both geographic Information system (GIS) and network Analysis are burgeoning fields, characterized by rapid Methodological and scientific advancement.

3. LOCATION STUDY AREA:

In the Uttaranchal, district of Nainital lies in the Kumaun division. To its north is Almora district and to its south lies theNainital district. Champawat district flanks it in the east and district of Pauri Gahwal is in the west. It is located approximately in between 80º14' and 78 º 80' east longitudes and 29º00' and 29º05' north latitude. On the northern side lies the Himalayan ranges while on the southern side lies the plains making the resultant climate of the district enjoyable one. The total geographical area is 3422 Kms. Geographically the district is divided in to 2 zones viz. Hilly and Bhabar.The hilly region in outer Himalayas is known to geologist as Krol. The highest peak of the district is Baudhansthali 2623 mts. high near Binayak adjoining Nainital town.The hilly region of the district .The hilly region of the district used to have big & small lakes. Bhimtal, Sattal, Naukuchiatal, Khurpatal, Nainital, Malwatal, Harishtal, Lokhamtal etc. are known lakes of bigger size.The foothill area of the district is known as Bhabhar. The name Bhabhar is derived from a tall growing grass growing in the region. The underground water level is very deep in this region.Kosi is the main river of the district .River Kosi arising out of Koshimool near Kausani flows on the western side of the district. There are number of smaller rivulets like Gaula , Bhakra , Dabka , Baur etc . Most of these have been dammed for irrigation purposes. Nainital district has good received good rainfall in recent years . As per 1999 records total average rainfall of district was 1338.08 MM while total average rainfall up to Aug. 2000 was 1602.69 MM. Different stretches of roads in Nainital are maintained by NNPP and PWD. The traffic flow in the town causes congestion as there is limited road space available. Traffic restrictions are imposed to manage traffic. There are no intermediate modes of public transport in the town. Taxis are available for inter-city trips and rickshaws are available for journeys between specific points (p. 56). Most of the internal roads are single lane with a few exceptions. Pedestrian movement in the town is affected because of the absence of footpaths. Key issues related to roads and transport are presented on p. 56 Nainital, owing to its location, is colder than the rest of the hilly tract of Kumaon region. During monsoon, it gets heavy rainfall. The neighboring areas of Almoraand Ranikhet are warmer than Nainital. The monthly maximum and minimum Temperatures in the town range between 28 degree C and 7 degree C.The rainy season begins earlier than in the plains and continues up to the end ofSeptember. The hea he1999records, total average rainfall of district was 1338 mm. During winter, rains create a considerable fall in temperature.

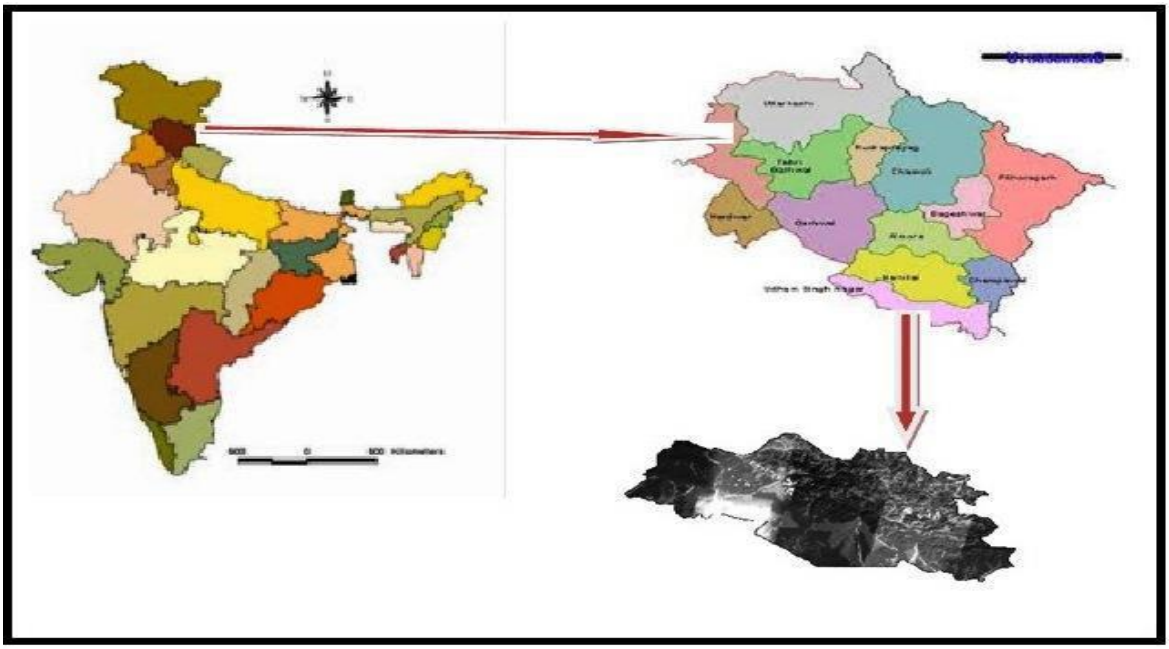

Figure-1: Location Map Nainital District

4. NETWORK ANALYSIS:

Network analysis in a GIS may be dependent on the utilities under concern, as each utility service would have customized requirement as discussed above. However, fundamental to these entire requirements would be the following analysis.

4.1 PATH DETERMINATION:

Path finding is the process of calculating an optimal path through series of points in a network and simulating the flow of resources through them. Path finding function could be the categorized into two major groups, the applications of which are different.

4.2 SOURCE – DESTINATION PATH:

An optimal path is from a pre-defined source to a pre-defined destination. In the case, the path of least resistance is determined from the source to the destination by evaluating the link.

4.3 OPTIMAL CYCLIC PATH:

Mainly as an implementation of the set-covering problem, an example of which could be the Traveling salesman's Problem. In this case, the problem is to determine the optimal path after visiting all or a specified set of links in the networks. In this case, the optimal path is determined from a matrix of resistance for each pair of links in the network. The matrix is evaluated to determine the order of visiting links in the network and to define the actual path.

4.3.1 Route analysis layer:

This layer contains the input network locations (stops and barriers), properties, and the resultant route or routes of a route analysis.

4.3.2 Closest facility analysis layer:

This layer contains the input network locations (facilities, incidents, and barriers), properties, and the resultant route or routes of a closest facility analysis.

4.3.3 Service area analysis layer:

This layer contains the input facilities and barriers, properties, and the resultant of service area Polygons and service area lines

4.3.4 OD cost matrix analysis layer:

This layer contains the input origins and destinations, properties, and resultant of an OD cost matrix analysis.

4.3.5 Vehicle routing problem analysis layer:

This layer contains the input network analysis objects (orders, depots, routes, depot visits, breaks, route zones, route seed points, route renewals, specialties, order pairs and barriers), properties, and the results of a vehicle routing problem analysis.

5. PREPARING NETWORK FOR ROUTING APPLICATIONS:

One of the most powerful analysis capabilities in ArcGIS is the finding shortest path or routing, command of the network module. It is not always an elementary task, however, to use the module for deriving or updating paths that are real – world solutions to various Routing problems.

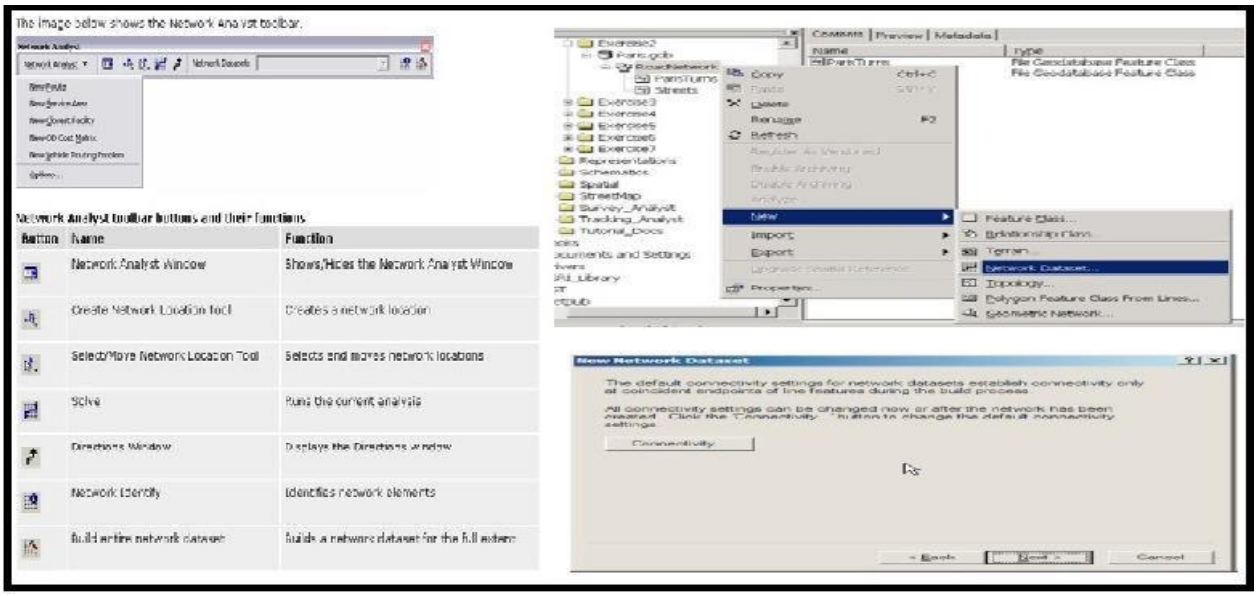

Figure-2: NETWORK ANALYSIST TOOLBAR

6. RESULT AND DISCUSION:

Network analysis is used for identifying the most efficient routes or paths for allocation of services. This involves finding the shortest or least-cost manner in which to visit a location or a set of locations in a network. ArcGIS Network Analyst allows you to solve common network problems, such as finding the best route across a city, finding the closest emergency vehicle or facility, identifying a service area around a location, or servicing a set of orders with a fleet of vehicles.

ArcGIS Network Analyst allows you to solve common network problems, such as finding the best route across a city, finding the closest emergency vehicle or facility, identifying a service area around a location, or

servicing a set of orders with a fleet of vehicles. The reason for finding the shortest path between two places is to connect by the best route which can be in terms of length of time. It is the best way to get from one location to another or the best way to visit several locations. It determines the order of location specified by the user. It can be Quickest, fastest or most scenic route depending upon impedance because it can be depend upon Impedance (cost attribute) chosen by us.

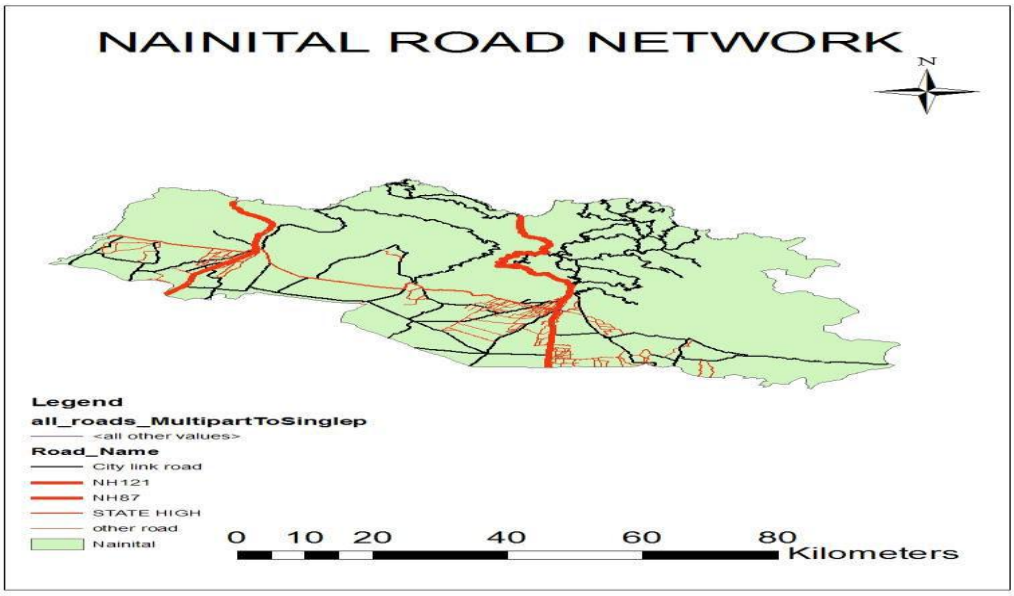

Fig-3: Nainital Road Network Map

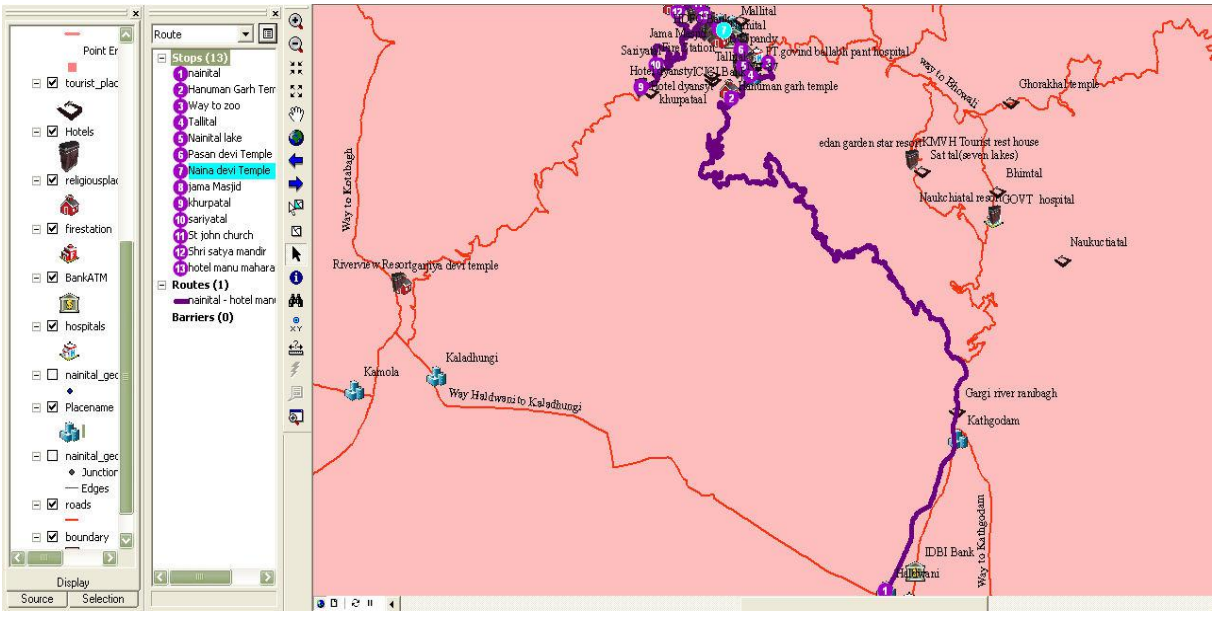

Figure-4: closest facility Map

Figure-4: closest facility Map	
Figure-4: closest facility Map	Service Time (in Minutes)
Figure-4: closest facility Map	30
Figure-4: closest facility Map	120
Figure-4: closest facility Map	30
Figure-4: closest facility Map	150
Figure-4: closest facility Map	30
Figure-4: closest facility Map	45
Figure-4: closest facility Map	30
Figure-4: closest facility Map	60
Figure-4: closest facility Map	60
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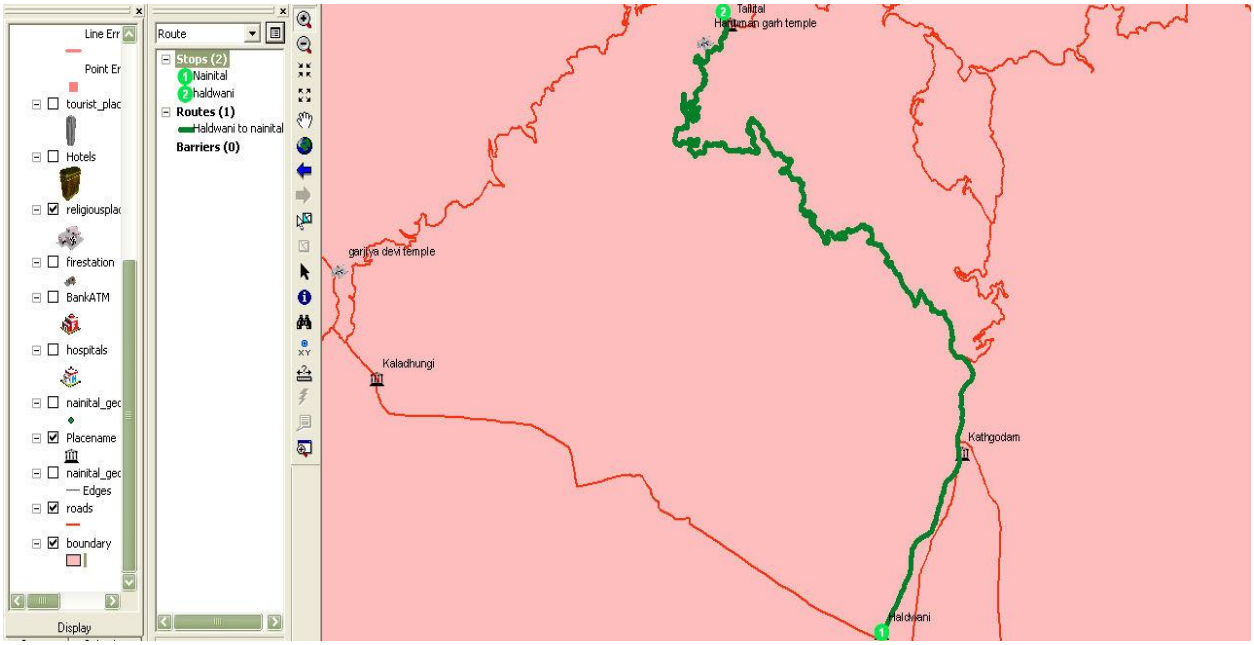

Figure-5:Best Route Map Nainital

7. CONCLUSION:

This paper introduced the ArcGIS transportation data model for Nainital City Through the well-established vector data structure, GIS has provided an efficient means for organizing basic transportation related data in order to facilitate the input, analysis, and display of transport networks.. The ArcGIS Transportation Data Model is designed to help in the development of transportation Applications. It does so by providing a context within which a transportation system can be described, and assisting in the development of a geo databases. The ArcGIS Transportation Data Model takes advantage of the flexibility of Object Orientation to define entities and the relationships among those entities. The present work was carried on with the motive of finding the shortest route. The road network of the study area is very poorly planned, they are quite narrow to allow big vehicles to move motley, most of the roads are suitable for pedestrians only. Network analysis for Tourism Destinations with a remote sensing and GIS perspective has been analyzed for the study area.

The main findings of the study are:

- If length is chosen as impedance, shortest path by length found, but if takes more time as time impedance creates quickest route.
- Shortest path in terms of length is best for tourist route.
- Obtaining the visual and detailed information about the tourist places and network analysis application for optimum planning for sightseeing enhances the potential of tourism.
- GIS application for tourism and network analysis help users to supply optimum planning for tourism. Moreover, users can save time via GIS usage.

8. RECOMMENDATIONS:

Tourism investigates the user of GIS for tourism research in storing, manipulating and analyzing the voluminous tourism data and survey carried out. Using high-resolution satellite data for the study give more impressive results. Future studies can explore the opportunities in development of roads.

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